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• Structural • Civil •

# **DRAINAGE STRATEGY**

For

NEW INDUSTRIAL UNITS  
PARK HOUSE, RADFORD HOLDINGS  
MILE END ROAD  
COLWICK  
NOTTINGHAM

DATE: February 2023

REF: 6142/DS01

REV: B

**KEITH SIMPSON ASSOCIATES LTD**  
**7c Colwick Quays Business Park**  
**Road No.2**  
**Colwick**  
**Nottingham**  
**NG4 2JY**

**(Company Registration No 2744103)**

## REVISION HISTORY

REVISION	DATE	REVISIONS	AUTHOR	CHECKED
A	10/02/23	First issue	SR	NH
B	17/10/23	Site plan amended	SR	NH

## BRIEF

This document highlights the proposed drainage strategy in support of the planning application for a new industrial development at Mile End Road, Colwick, Nottingham. This document is to be read in conjunction with Keith Simpson Associates Ltd drainage layout drawing 6142-DR-01 (see Appendix A).

## INTRODUCTION

The proposals are for the construction of 5no new industrial units on the site of a former office building. The site is located approximately 4km East of Nottingham City Centre. The site is bound to the south by Mile End Road and to the east by industrial units. Residential dwellings bound the site to the north and west.

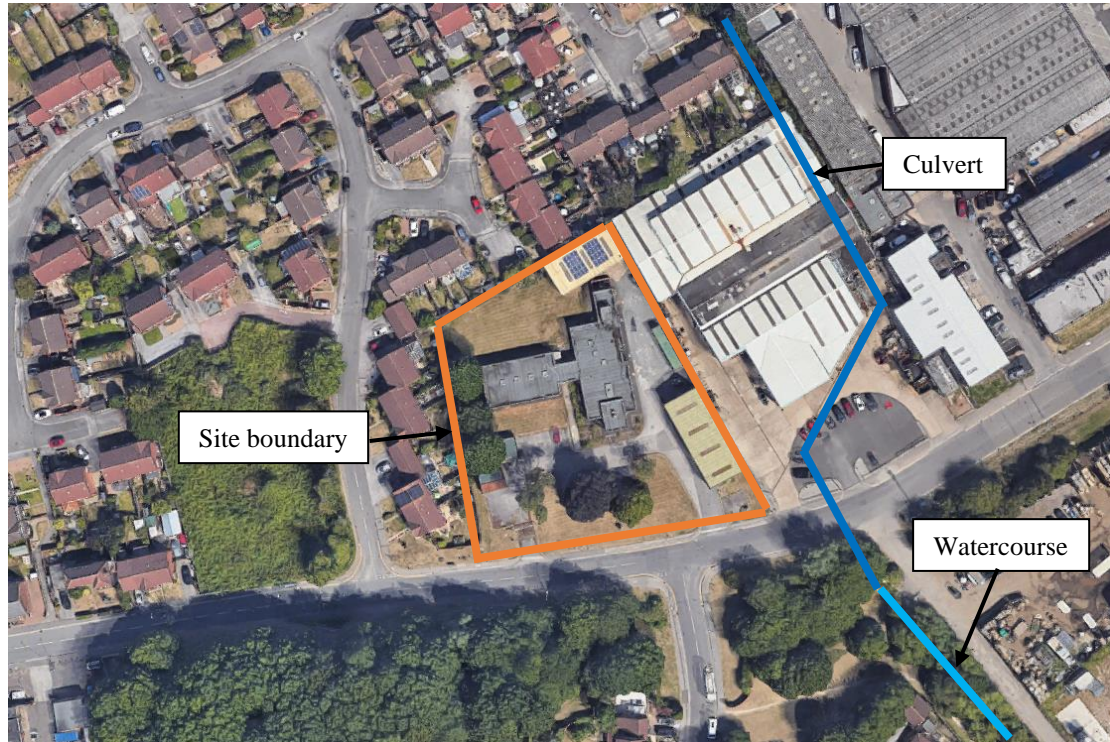


Figure 1. Aerial photograph of site location

## EXISTING CONDITIONS

The site consists of an existing office buildings and asphalt car park. A topographical and utilities survey has been carried out, see Appendix B. The site is relatively flat with existing levels ranging from 20.95mAOD to 21.35mAOD. The area of existing roofs and hardstanding is approximately 2200m<sup>2</sup>.

The River Trent is located 500m to the south of the site and flows in a north-eastern direction. An un-named watercourse is located to the south of the development which outfalls to the River Trent, this watercourse is culverted below the adjacent industrial unit.

A sewer map has been obtained from Severn Trent Water, see Appendix C. The site is currently served by a 150Ø foul drain which is assumed to discharge to the 225Ø foul sewer in Mile End

Road and a 150Ø surface water drain which is assumed to discharge to the watercourse / culvert to the east of the site.

## PROPOSED FOUL WATER DRAINAGE

It is proposed to connect the foul water from the development into the 150Ø foul drain on site which is believed to discharge into the 225Ø foul sewer in Mile End Road.

## PROPOSED SURFACE WATER DRAINAGE

The surface water drainage system has been designed with reference to the CIRIA SuDS Manual and Planning Practice Guidance to ensure sustainability and minimise flood risk.

The Planning Practice Guidance states:

*“Generally, the aim should be to discharge surface run off as high up the following hierarchy of drainage options as reasonably practicable:*

- 1. into the ground (infiltration);*
- 2. to a surface water body;*
- 3. to a surface water sewer, highway drain, or another drainage system;*
- 4. to a combined sewer.”*

A geotechnical site investigation has been carried out which found the ground conditions to comprise of made ground overlying sandy gravelly clay. Groundwater levels were recorded approximately 1.5m deep. On this basis it is advised that soakaways will not be viable on this site.

The closest watercourse to the site is an unnamed watercourse located to the south east of the site which is a tributary to the River Trent. It is proposed to re-use the existing surface water connection which is believed to outfall to this watercourse.

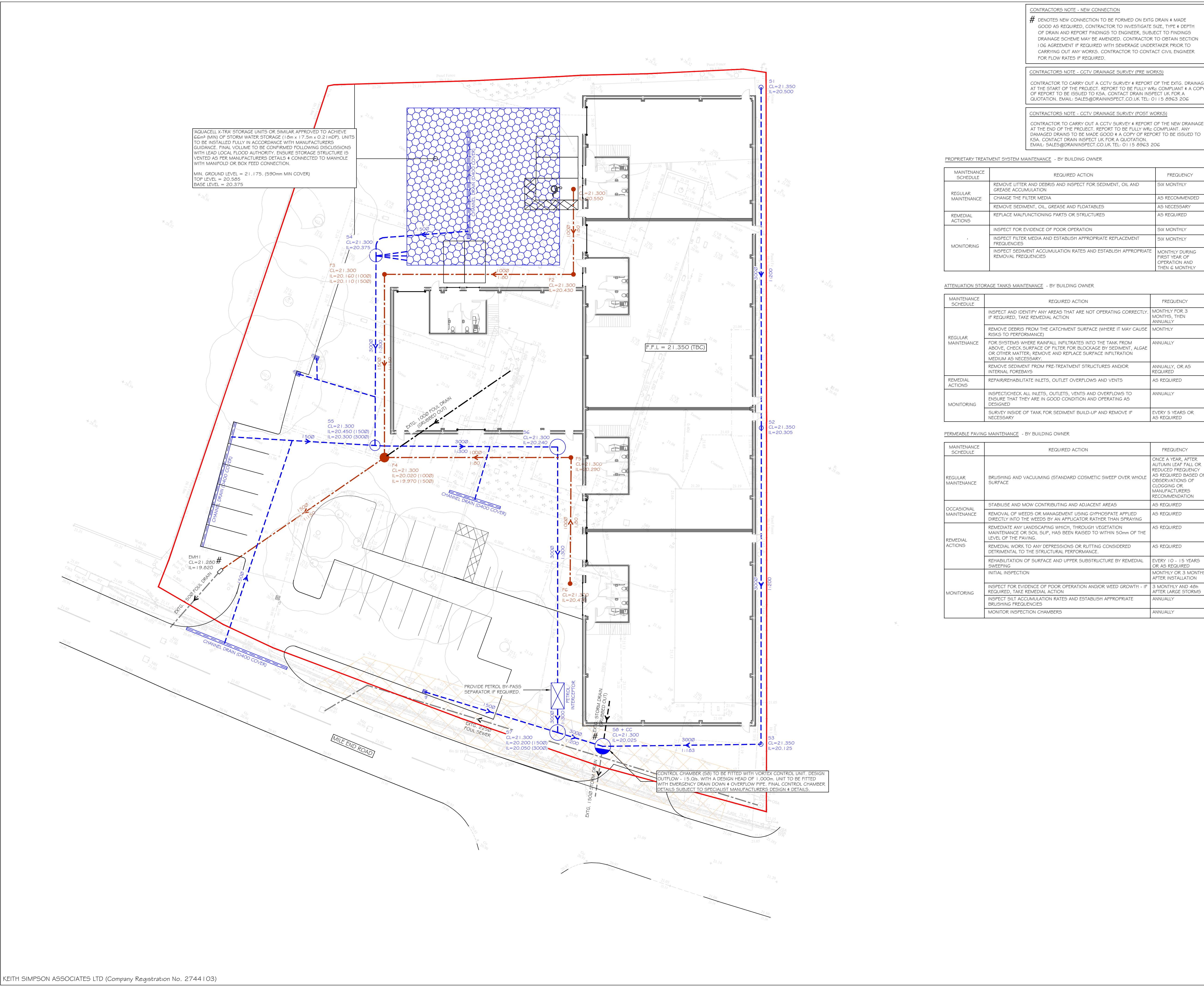
Based on the existing impermeable area of the site, 2200m<sup>2</sup>, the existing surface water discharge rate has been calculated as 30l/s. It is proposed to provide a 50% reduction in surface water flows and limit the discharge rate to 15l/s.

A new drainage system will be provided to the site which will be drained via channel drains, gullies and an area of permeable car park. The first 5mm of rainfall will be retained on site through surface wetting and the filling of the sump within the control chamber and gullies. Flows from the buildings and hardstanding will be stored in an attenuation tank and a vortex control unit will be used to attenuate discharge to 15l/s. The site drainage system will cater for all rainfall events up to a 100 year return period, see PDS Flow calculations in Appendix D. The 100 year + 40% climate change event results in 20m<sup>3</sup> of flooding which will be retained in the car park area and not affect the building.

# **Appendix A**

## Proposed Drainage Layout





AQUACELL X-TRA STORAGE UNITS OR SIMILAR APPROVED TO ACHIEVE 66m³ (MIN) OF STORM WATER STORAGE (1.0m x 1.75m x 0.21m DP). UNITS TO BE INSTALLED FULLY IN ACCORDANCE WITH MANUFACTURERS GUIDANCE. FINAL VOLUME TO BE CONFIRMED FOLLOWING DISCUSSIONS WITH LEAD LOCAL FLOOD AUTHORITY. ENSURE STORAGE STRUCTURE IS VENTED AS PER MANUFACTURERS DETAILS & CONNECTED TO MANHOLE WITH MANFOLD OR BOX FEED CONNECTION.

MIN. GROUND LEVEL = 21.175. (590mm MIN COVER)  
 TOP LEVEL = 20.585  
 BASE LEVEL = 20.375

CONTROL CHAMBER (S8) TO BE FITTED WITH VORTEX CONTROL UNIT. DESIGN OUTFLOW - 15.0s WITH A DESIGN HEAD OF 1.000m. UNIT TO BE FITTED WITH EMERGENCY DRAIN DOWN & OVERFLOW PIPE. FINAL CONTROL CHAMBER DETAILS SUBJECT TO SPECIALIST MANUFACTURERS DESIGN & DETAILS.

**CONTRACTORS NOTE - NEW CONNECTION**  
 # DENOTES NEW CONNECTION TO BE FORMED ON EXTG DRAIN # MADE GOOD AS REQUIRED. CONTRACTOR TO INVESTIGATE SIZE, TYPE & DEPTH OF DRAIN AND REPORT FINDINGS TO ENGINEER, SUBJECT TO FINDINGS DRAINAGE SCHEME MAY BE AMENDED. CONTRACTOR TO OBTAIN SECTION 106 AGREEMENT IF REQUIRED WITH SEWERAGE UNDERTAKER PRIOR TO CARRYING OUT ANY WORKS. CONTRACTOR TO CONTACT CIVIL ENGINEER FOR FLOW RATES IF REQUIRED.

**CONTRACTORS NOTE - CCTV DRAINAGE SURVEY (PRE WORKS)**  
 CONTRACTOR TO CARRY OUT A CCTV SURVEY & REPORT OF THE EXTG. DRAINAGE AT THE START OF THE PROJECT. REPORT TO BE FULLY WRc COMPLIANT & A COPY OF REPORT TO BE ISSUED TO KSA. CONTACT DRAIN INSPECT UK FOR A QUOTATION. EMAIL: SALES@DRAININSPECT.CO.UK TEL: 0115 8963 206

**CONTRACTORS NOTE - CCTV DRAINAGE SURVEY (POST WORKS)**  
 CONTRACTOR TO CARRY OUT A CCTV SURVEY & REPORT OF THE NEW DRAINAGE AT THE END OF THE PROJECT. REPORT TO BE FULLY WRc COMPLIANT. ANY DAMAGED DRAINS TO BE MADE GOOD & A COPY OF REPORT TO BE ISSUED TO KSA. CONTACT DRAIN INSPECT UK FOR A QUOTATION. EMAIL: SALES@DRAININSPECT.CO.UK TEL: 0115 8963 206

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**NOTES:**  
 DO NOT SCALE. All dimensions to be checked / verified on site.  
 All drawings to be read in conjunction with Architects / Civil Engineers drawings & specification.  
 Drainage connections to sewers and making good to be in accordance with the latest edition Sewers for Adoption.  
 Any new connections, including the re-use of existing connections, to the public sewerage system will require a formal Section 106 agreement with the sewerage undertaker. The contractor / developer is responsible for obtaining Section 106 approval prior to carrying out any works. Engineer to be contacted for flow rates if required.  
 Drainage works to be in accordance with Building Regulations Part H.  
 The contractor must establish the line of the existing infrastructure drainage and all services prior to commencement of any new connection works.  
 Trenches within 1.0m of load bearing walls to be backfilled with designated concrete Gen 1 to at least the underside of the foundation. Where the distance is greater than 1.0m from the wall, concrete backfill should be to a level below the underside of the foundation equal to the distance from the wall to the near side of the trench less 150mm.  
 Pipes to be bedded in class 5 granular bed & surround where cover is 0.6m or greater in landscaping or where cover is 1.2m or greater in driveways and roads. Where cover is less than 0.6m in landscaping or less than 1.2m in driveways & roads class A concrete bed & surround or concrete protection slab to be provided. See pipe bedding details.  
 All pipework to be vitrified clay to BS 65, BS EN 295  
 Contractor to carry out all necessary water testing of the drainage system prior to backfilling in order to satisfy himself of the adequacy of the workmanship.  
 Manhole cover levels are approximate only and may require some adjustment to suit actual ground & finished levels.  
 Internal building drainage to be detailed by Architect.  
 All external levels and threshold levels to be detailed by Architect / others.  
 All building drainage components to be Hepworth or similar approved by KSA.  
 All drainage to be laid with level soft connections.  
 Contractor to trial hole the existing services within the development prior to commencement of drainage works as necessary to satisfy himself of the line and level of any services.  
 Contractor to allow for the temporary diversion of the flows associated with the existing drainage system both on and off site, as required.  
 The Contractor should note that ground water may be encountered during the works and should therefore make adequate provisions.  
 Testing to be carried out on all drainage runs prior to handover & results to be issued to design team.

**PROPRIETARY TREATMENT SYSTEM MAINTENANCE - BY BUILDING OWNER**

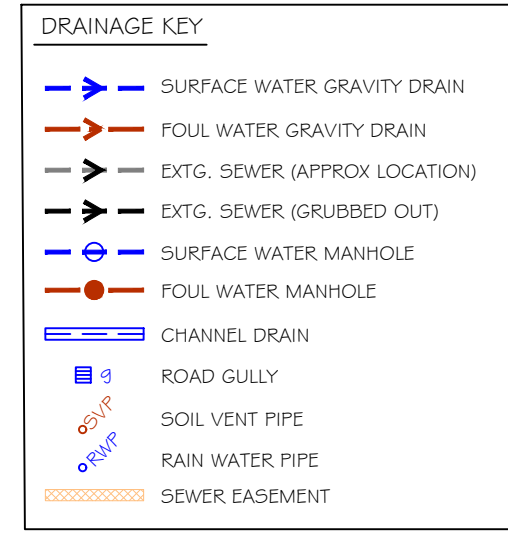
MAINTENANCE SCHEDULE	REQUIRED ACTION	FREQUENCY
REGULAR MAINTENANCE	REMOVE LITTER AND DEBRIS AND INSPECT FOR SEDIMENT, OIL AND GREASE ACCUMULATION	SIX MONTHLY
	CHANGE THE FILTER MEDIA	AS RECOMMENDED
REMEDIAL ACTIONS	REMOVE SEDIMENT, OIL, GREASE AND FLOATABLES	AS NECESSARY
	REPLACE MALFUNCTIONING PARTS OR STRUCTURES	AS REQUIRED
MONITORING	INSPECT FOR EVIDENCE OF POOR OPERATION	SIX MONTHLY
	INSPECT FILTER MEDIA AND ESTABLISH APPROPRIATE REPLACEMENT FREQUENCIES	SIX MONTHLY
	INSPECT SEDIMENT ACCUMULATION RATES AND ESTABLISH APPROPRIATE REMOVAL FREQUENCIES	MONTHLY DURING FIRST YEAR OF OPERATION AND THEN 6 MONTHLY

**ATTENUATION STORAGE TANKS MAINTENANCE - BY BUILDING OWNER**

MAINTENANCE SCHEDULE	REQUIRED ACTION	FREQUENCY
REGULAR MAINTENANCE	INSPECT AND IDENTIFY ANY AREAS THAT ARE NOT OPERATING CORRECTLY. IF REQUIRED, TAKE REMEDIAL ACTION	MONTHLY FOR 3 MONTHS, THEN ANNUALLY
	REMOVE DEBRIS FROM THE CATCHMENT SURFACE (WHERE IT MAY CAUSE RISKS TO PERFORMANCE)	MONTHLY
	FOR SYSTEMS WHERE RAINFALL INFILTRATES INTO THE TANK FROM ABOVE, CHECK SURFACE OF FILTER FOR BLOCKAGE BY SEDIMENT, ALGAE OR OTHER MATTER, REMOVE AND REPLACE SURFACE INFILTRATION MEDIUM AS NECESSARY	ANNUALLY
REMEDIAL ACTIONS	REMOVE SEDIMENT FROM PRE-TREATMENT STRUCTURES AND/OR INTERNAL FOREBAYS	ANNUALLY, OR AS REQUIRED
	REPAIR/REHABILITATE INLETS, OUTLET OVERFLOWS AND VENTS	AS REQUIRED
MONITORING	INSPECT/CHECK ALL INLETS, OUTLETS, VENTS AND OVERFLOWS TO ENSURE THAT THEY ARE IN GOOD CONDITION AND OPERATING AS DESIGNED	ANNUALLY
	SURVEY INSIDE OF TANK FOR SEDIMENT BUILD-UP AND REMOVE IF NECESSARY	EVERY 5 YEARS OR AS REQUIRED

**PERMEABLE PAVING MAINTENANCE - BY BUILDING OWNER**

MAINTENANCE SCHEDULE	REQUIRED ACTION	FREQUENCY
REGULAR MAINTENANCE	BRUSHING AND VACUUMING (STANDARD COSMETIC SWEEP OVER WHOLE SURFACE)	ONCE A YEAR, AFTER AUTUMN LEAF FALL OR REDUCED FREQUENCY AS REQUIRED BASED ON OBSERVATIONS OF CLOGGING OR MANUFACTURERS RECOMMENDATION
	OCCASIONAL MAINTENANCE	STABILISE AND MOW CONTRIBUTING AND ADJACENT AREAS
REMEDIAL ACTIONS	REMOVAL OF WEEDS OR MANAGEMENT USING GYHOSPHATE APPLIED DIRECTLY INTO THE WEEDS BY AN APPLICATOR RATHER THAN SPRAYING	AS REQUIRED
	REMEDIAL WORK TO ANY DEPRESSIONS OR RUTTING CONSIDERED DETRIMENTAL TO THE STRUCTURAL PERFORMANCE.	AS REQUIRED
MONITORING	REHABILITATION OF SURFACE AND UPPER SUBSTRUCTURE BY REMEDIAL SWEEPING	EVERY 10 - 15 YEARS OR AS REQUIRED
	INITIAL INSPECTION	MONTHLY OR 3 MONTHS AFTER INSTALLATION
	INSPECT FOR EVIDENCE OF POOR OPERATION AND/OR WEED GROWTH - IF REQUIRED, TAKE REMEDIAL ACTION	3 MONTHLY AND 4th AFTER LARGE STORMS
	INSPECT SILT ACCUMULATION RATES AND ESTABLISH APPROPRIATE BRUSHING FREQUENCIES	ANNUALLY
	MONITOR INSPECTION CHAMBERS	ANNUALLY



P5	25/10/23	SITE LAYOUT AMENDED	SR	NH
P4	17/10/23	SITE LAYOUT AMENDED	SR	NH
P3	12/09/23	SCHEME AMENDED	SR	NH
P2	10/02/23	SITE PLAN UPDATED	TB	NH
P1	01/02/23	PRELIMINARY ISSUE	TB	NH
Rev	Date	Description	Drwn	Chkd

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Client  
 RADFORD HOLDINGS

Project  
 PARK HOUSE  
 MILE END ROAD  
 COLWICK  
 NOTTINGHAM

Drawing Title  
 DRAINAGE LAYOUT

Managing Engineer  
 NICK HUDSON

Scale  
 1:200

Date  
 FEB 23

Size  
 A1

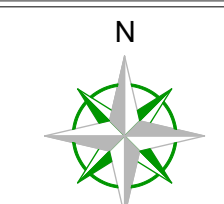
Status  
 PRELIMINARY

Drw. No.	6142-DR-01	Rev.	P5
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# **Appendix B**

## Topographical & Utilities Survey





Station Information:

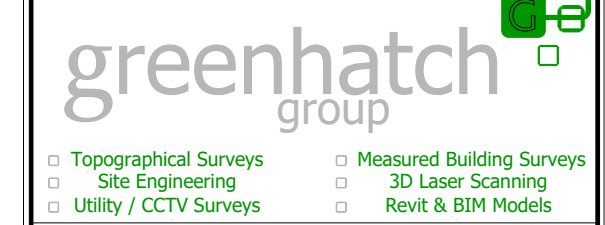
Station	Easting (m)	Northing (m)	Level (m)
W1	461545.457	340066.555	21.183
W2	461472.933	340053.194	21.072
W3	461463.955	340108.341	21.452
W4	461508.145	340129.980	21.092
W1A	461495.293	340082.755	21.152

**OS Note:**  
 Some services may have been omitted due to parked vehicles. This survey has been orientated to the Ordnance Survey (OS) National Grid OSGB36(15) via Global Navigation Satellite Systems (GNSS) and the OS Active Network (OS Net).  
 A true OSGB36 coordinate has been established near to the site centre via a transformation using the OSTN15GB & OSGB15GB transformation models.  
 The survey has been correlated to this point and a further one or more OSGB36 (15) points established to create a true O.S. bearing for angle orientation.  
 No scale factor has been applied to the survey therefore the coordinates shown are arbitrary & not true O.S. Coordinates which have a scale factor applied.  
 Please refer to Survey Station Table to enable establishment of the on-site grid and datum.

**Legend:**

Symbol	Description	Code
[Symbol]	Boundary	B
[Symbol]	Concrete	C
[Symbol]	Drainage	D
[Symbol]	Electric	E
[Symbol]	Gas	G
[Symbol]	Grass	Gr
[Symbol]	Level	L
[Symbol]	Manhole	M
[Symbol]	Obstacle	O
[Symbol]	Pipe	P
[Symbol]	Structure	S
[Symbol]	Tarmac	T
[Symbol]	Vegetation	V
[Symbol]	Water	W
[Symbol]	Wall	Wa
[Symbol]	Window	Win
[Symbol]	Yard	Y

Rev	Date	Description	Drawn	By	Check



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St Albans	Newcastle	London
Heckfield	Newcastle Bus Park	Repsart Park
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**CLIENT**  
**Meller Limited**

**PROJECT**  
**Radford's Holdings, Park House, Mile End Road, Colwick, Notts, NG4 2DW**

**TITLE**  
**Topographical Survey**

SCALE	DATE
A1@ 1:200	05.05.22
DRAWN	QUALITY REF
WA	GH13641

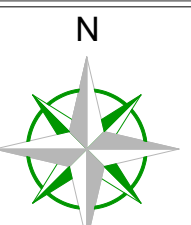
Level datum	See note
Grid orientation	See note
Job number	43682
Drawing No.	43682_T
Rev.	0

**Comments**  
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 All dimensions should be checked on site prior to design and construction.  
 Drainage information (where applicable) has been visually inspected from the surface and therefore should be treated as approximate only.

**Notes:**







**NOTES:**  
 All work shown on this plan is based on the information provided to Greenhatch Group by the client. Greenhatch Group does not accept responsibility for the accuracy of the information provided to it.  
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**UTILITY LINE TYPES**

Utility	Line Type	Color	Symbol
Water	Water	Blue	Blue
Gas	Gas	Red	Red
Electricity	Electricity	Yellow	Yellow
Telecom	Telecom	Green	Green
Drainage	Drainage	Magenta	Magenta
Other	Other	Grey	Grey

**UTILITY SURVEY INFORMATION**

Utility	Depth	Material	Notes
Water	1.5m	HDPE	
Gas	1.0m	PE	
Electricity	0.75m	PVC	
Telecom	0.5m	PVC	
Drainage	0.75m	Concrete	

**LEGEND**

Symbol	Description
Circle with cross	Level point
Circle with dot	Spot level
Circle with 'x'	Spot level
Circle with 'y'	Spot level
Circle with 'z'	Spot level
Circle with 'a'	Spot level
Circle with 'b'	Spot level
Circle with 'c'	Spot level
Circle with 'd'	Spot level
Circle with 'e'	Spot level
Circle with 'f'	Spot level
Circle with 'g'	Spot level
Circle with 'h'	Spot level
Circle with 'i'	Spot level
Circle with 'j'	Spot level
Circle with 'k'	Spot level
Circle with 'l'	Spot level
Circle with 'm'	Spot level
Circle with 'n'	Spot level
Circle with 'o'	Spot level
Circle with 'p'	Spot level
Circle with 'q'	Spot level
Circle with 'r'	Spot level
Circle with 's'	Spot level
Circle with 't'	Spot level
Circle with 'u'	Spot level
Circle with 'v'	Spot level
Circle with 'w'	Spot level
Circle with 'x'	Spot level
Circle with 'y'	Spot level
Circle with 'z'	Spot level

**PAB 100: 2022 LEVEL 8 SURVEY**

Area	Level	Notes
Area 1	21.00	
Area 2	21.00	
Area 3	21.00	
Area 4	21.00	
Area 5	21.00	
Area 6	21.00	
Area 7	21.00	
Area 8	21.00	
Area 9	21.00	
Area 10	21.00	
Area 11	21.00	
Area 12	21.00	
Area 13	21.00	
Area 14	21.00	
Area 15	21.00	
Area 16	21.00	
Area 17	21.00	
Area 18	21.00	
Area 19	21.00	
Area 20	21.00	

**DISCLAIMER**  
 Whilst every effort has been taken in the preparation of this drawing, the original field notes, observations and measurements are the responsibility of the surveyor. Greenhatch Group does not accept responsibility for the accuracy of the information provided to it.  
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Rev	Date	Description	Drawn	Cd
1				

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**Meller Limited**

**PROJECT**  
**Radford's Holdings, Park House, Mile End Road, Colwick, Notts, NG4 2DW**

**TITLE**  
**Utility Survey**

**SCALE**  
**A1@ 1:200**

**DATE**  
**19/12/22**

**DRAWN**  
**JR/DC**

**QUALITY REF**  
**GH1675**

**Level datum**  
 See note

**Grid orientation**  
 See note

**Job number**  
**43682**

**Drawing No.**  
**43682\_T\_UG**

**Rev.**  
**0**

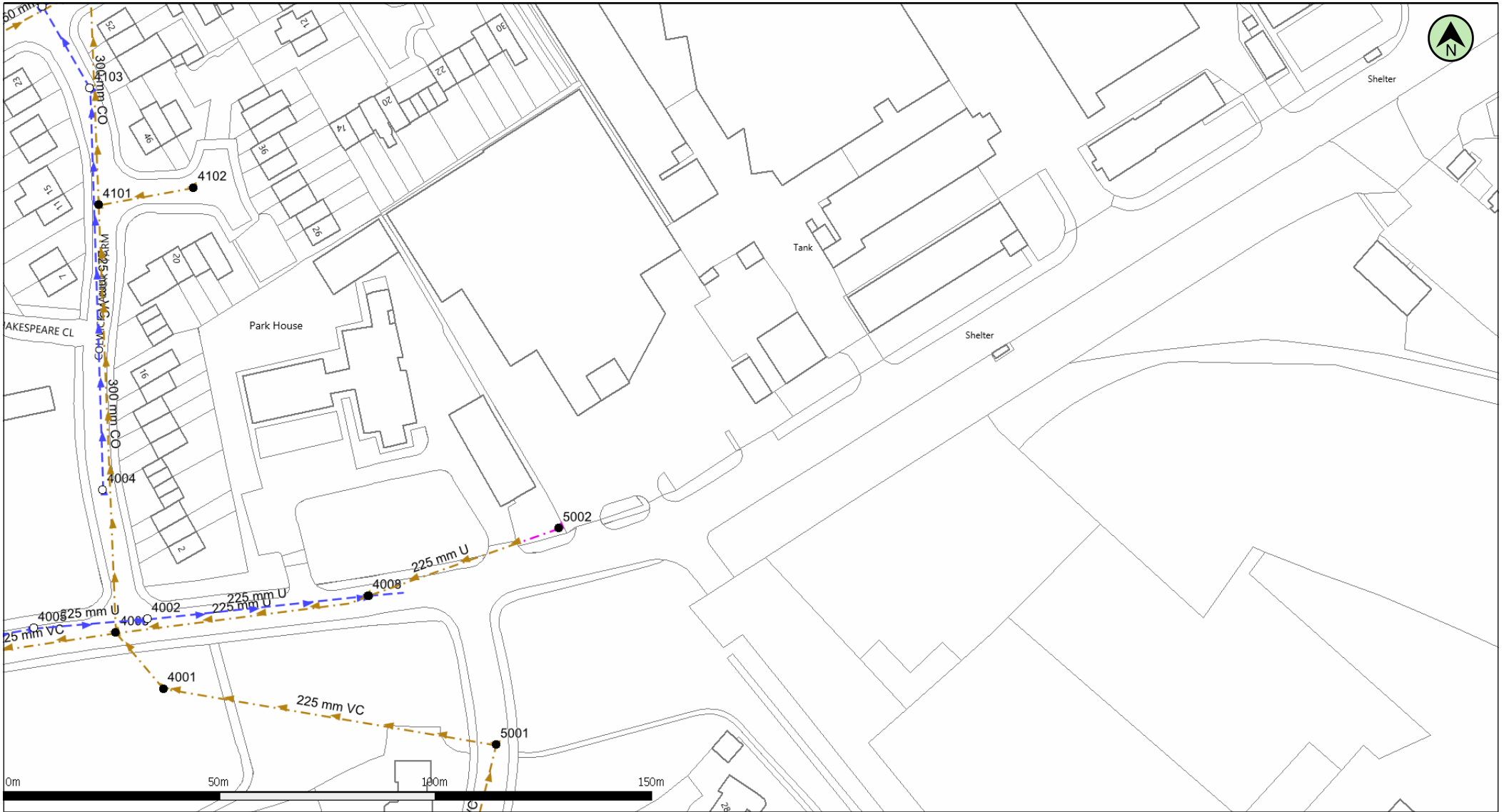
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**Notes:**



# **Appendix C**

## STW Sewer Map



(c) Crown copyright and database rights 2019 Ordnance Survey 100031673      Date: 11/11/19      Scale: 1:1250      Map Centre: 461588,340096      Data updated: 31/07/19      Our Ref: 352807 - 2      Wastewater Plan A4

Do not scale off this Map. This plan and any information supplied with it is furnished as a general guide, is only valid at the date of issue and no warranty as to its correctness is given or implied. In particular this plan and any information shown on it must not be relied upon in the event of any development or works (including but not limited to excavations) in the vicinity of SEVERN TRENT WATER assets or for the purposes of determining the suitability of a point of connection to the sewerage or distribution systems. On 1 October 2011 most private sewers and private lateral drains in Severn Trent Water's sewerage area, which were connected to a public sewer as at 1 July 2011, Transferred to the ownership of Severn Trent Water and became public sewers and public lateral drains. A further transfer takes place on 1 October 2012. Private pumping stations, which form part of these sewers or lateral drains, will transfer to ownership of Severn Trent Water on or before 1 October 2016. Severn Trent Water does not possess complete records of these assets. These assets may not be displayed on the map. Reproduction by permission of Ordnance Survey on behalf of HMSO. © Crown Copyright and database right 2004. All rights reserved. Ordnance Survey licence number: 100031673. Document users other than SEVERN TRENT WATER business users are advised that thi

Public Foul Gravity/Lateral Drain		Highway Drain		Manhole Foul	
Public Combined Gravity/Lateral Drain		Overflow Pipe		Manhole Surface	
Public Surface Water Gravity/Lateral Drain		Disposal Pipe		Abandoned Pipe	
Pressure Foul		Culverted Water Course		Section 104 sewers are shown in green	
Pressure Combined		Pumping Station		Private sewers are shown in magenta	
Pressure Surface Water		Fitting			

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NG4 2BU



# **Appendix D**

## PDS Flow Calculations





**Design Settings**

Rainfall Methodology	FSR	Maximum Time of Concentration (mins)	30.00
Return Period (years)	100	Maximum Rainfall (mm/hr)	50.0
Additional Flow (%)	0	Minimum Velocity (m/s)	1.00
FSR Region	England and Wales	Connection Type	Level Soffits
M5-60 (mm)	18.700	Minimum Backdrop Height (m)	0.200
Ratio-R	0.400	Preferred Cover Depth (m)	1.200
CV	0.750	Include Intermediate Ground	✓
Time of Entry (mins)	5.00	Enforce best practice design rules	✓

**Nodes**

Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Easting (m)	Northing (m)	Depth (m)
1	0.023	5.00	21.350	475	461473.916	340113.316	0.850
2	0.034	5.00	21.350	475	461473.940	340074.309	1.045
3	0.025	5.00	21.350	475	461473.903	340038.097	1.226
Attenuation	0.020	5.00	21.300	1200	461434.483	340093.924	0.924
Channel 3	0.030	5.00	21.175	300	461430.818	340097.414	0.675
4	0.046	5.00	21.300	1800	461430.834	340093.858	0.925
Channel 1		5.00	21.150	300	461413.224	340073.286	0.650
5	0.030	5.00	21.300	1500	461430.757	340072.239	0.997
6	0.039	5.00	21.300	1200	461450.615	340072.239	1.063
Channel 2	0.041	5.00	21.000	300	461440.799	340057.677	0.500
Junction 1			21.300		461450.614	340059.206	1.138
7	0.047	5.00	21.300	1200	461450.615	340039.437	1.250
8			21.300	1800	461455.783	340037.857	1.275
8_OUT			21.300	1200	461456.134	340033.751	1.292

**Links**

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
1.000	1	2	39.007	0.600	20.500	20.305	0.195	200.0	300	5.59	50.0
1.001	2	3	36.212	0.600	20.305	20.124	0.181	200.1	300	6.13	50.0
1.002	3	8	18.122	0.600	20.124	20.025	0.099	183.0	300	6.39	50.0
2.000	Attenuation	4	3.650	0.600	20.376	20.375	0.001	3649.6	300	5.24	50.0
3.000	Channel 3	4	3.556	0.600	20.500	20.375	0.125	28.4	300	5.02	50.0
2.001	4	5	21.619	0.600	20.375	20.303	0.072	300.3	300	5.64	50.0
4.000	Channel 1	5	17.564	0.600	20.500	20.303	0.197	89.2	300	5.18	50.0
2.002	5	6	19.858	0.600	20.303	20.237	0.066	300.9	300	6.01	50.0
2.003	6	Junction 1	13.033	0.600	20.237	20.162	0.075	173.8	300	6.19	50.0

Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)	Pro Depth (mm)	Pro Velocity (m/s)
1.000	1.108	78.3	3.1	0.550	0.745	0.023	0.0	41	0.546
1.001	1.108	78.3	7.7	0.745	0.926	0.057	0.0	63	0.710
1.002	1.159	81.9	11.1	0.926	0.975	0.082	0.0	74	0.815
2.000	0.251	17.7	2.7	0.624	0.625	0.020	0.0	79	0.182
3.000	2.958	209.1	4.1	0.375	0.625	0.030	0.0	29	1.186
2.001	0.902	63.7	13.0	0.625	0.697	0.096	0.0	92	0.713
4.000	1.666	117.7	0.0	0.350	0.697	0.000	0.0	0	0.000
2.002	0.901	63.7	17.1	0.697	0.763	0.126	0.0	106	0.767
2.003	1.189	84.1	22.4	0.763	0.838	0.165	0.0	105	1.010

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
5.000	Channel 2	Junction 1	9.933	0.600	20.500	20.237	0.263	37.8	225	5.08	50.0
2.004	Junction 1	7	19.769	0.600	20.162	20.050	0.112	176.5	300	6.47	50.0
2.005	7	8	5.404	0.600	20.050	20.025	0.025	216.2	300	6.56	50.0
1.003	8	8_OUT	4.121	0.600	20.025	20.008	0.017	242.4	300	6.62	50.0

Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)	Pro Depth (mm)	Pro Velocity (m/s)
5.000	2.135	84.9	5.6	0.275	0.838	0.041	0.0	39	1.222
2.004	1.180	83.4	27.9	0.838	0.950	0.206	0.0	119	1.066
2.005	1.065	75.3	34.3	0.950	0.975	0.253	0.0	142	1.041
1.003	1.005	71.1	45.4	0.975	0.992	0.335	0.0	174	1.064

Simulation Settings

Rainfall Methodology	FSR	Analysis Speed	Detailed
FSR Region	England and Wales	Skip Steady State	x
M5-60 (mm)	18.700	Drain Down Time (mins)	240
Ratio-R	0.400	Additional Storage (m <sup>3</sup> /ha)	0.0
Summer CV	0.750	Check Discharge Rate(s)	x
Winter CV	0.840	Check Discharge Volume	x

Storm Durations

15	60	180	360	600	960	2160	4320
30	120	240	480	720	1440	2880	5760

Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
1	0	0	0
30	0	0	0
100	0	0	0
100	40	0	0

Node 8 Online Hydro-Brake® Control

Flap Valve	x	Objective (HE)	Minimise upstream storage
Replaces Downstream Link	✓	Sump Available	✓
Invert Level (m)	20.025	Product Number	CTL-SHE-0175-1500-1000-1500
Design Depth (m)	1.000	Min Outlet Diameter (m)	0.225
Design Flow (l/s)	15.0	Min Node Diameter (mm)	1200

Node Attenuation Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	1.0	Invert Level (m)	20.376
Side Inf Coefficient (m/hr)	0.00000	Porosity	0.95	Time to half empty (mins)	77

Depth (m)	Area (m <sup>2</sup> )	Inf Area (m <sup>2</sup> )	Depth (m)	Area (m <sup>2</sup> )	Inf Area (m <sup>2</sup> )	Depth (m)	Area (m <sup>2</sup> )	Inf Area (m <sup>2</sup> )
0.000	315.0	0.0	0.210	315.0	0.0	0.211	0.0	0.0



**Results for 1 year Critical Storm Duration. Lowest mass balance: 99.83%**

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	1	11	20.539	0.039	3.0	0.0069	0.0000	OK
15 minute winter	2	14	20.415	0.110	7.4	0.0195	0.0000	OK
15 minute winter	3	14	20.419	0.295	13.0	0.0523	0.0000	OK
480 minute winter	Attenuation	344	20.396	0.020	0.6	5.9015	0.0000	OK
15 minute winter	Channel 3	10	20.528	0.028	3.9	0.0020	0.0000	OK
15 minute winter	4	10	20.448	0.073	9.9	0.1853	0.0000	OK
15 minute summer	Channel 1	1	20.500	0.000	0.0	0.0000	0.0000	OK
15 minute winter	5	15	20.411	0.108	12.3	0.1901	0.0000	OK
15 minute winter	6	15	20.421	0.184	16.8	0.2075	0.0000	OK
15 minute winter	Channel 2	10	20.539	0.039	5.4	0.0028	0.0000	OK
15 minute winter	Junction 1	14	20.414	0.252	21.5	0.0000	0.0000	OK
15 minute winter	7	13	20.414	0.364	23.0	0.4121	0.0000	SURCHARGED
15 minute winter	8	13	20.413	0.388	19.7	0.9878	0.0000	SURCHARGED
15 minute summer	8_OUT	1	20.008	0.000	15.0	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute winter	1	1.000	2	2.9	0.383	0.037	0.5269	
15 minute winter	2	1.001	3	8.0	0.538	0.102	1.6965	
15 minute winter	3	1.002	8	9.4	0.282	0.114	1.2741	
480 minute winter	Attenuation	2.000	4	-0.3	-0.206	-0.019	0.0072	
15 minute winter	Channel 3	3.000	4	3.9	0.521	0.019	0.0294	
15 minute winter	4	2.001	5	8.4	0.543	0.131	0.3431	
15 minute summer	Channel 1	4.000	5	0.0	0.000	0.000	0.1560	
15 minute winter	5	2.002	6	12.1	0.652	0.189	0.6737	
15 minute winter	6	2.003	Junction 1	16.2	0.775	0.192	0.6900	
15 minute winter	Channel 2	5.000	Junction 1	5.4	1.181	0.063	0.1801	
15 minute winter	Junction 1	2.004	7	17.2	0.557	0.206	1.3214	
15 minute winter	7	2.005	8	19.7	0.502	0.261	0.3805	
15 minute winter	8	Hydro-Brake®	8_OUT	15.0				18.5



**Results for 30 year Critical Storm Duration. Lowest mass balance: 99.83%**

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	1	12	20.903	0.403	14.8	0.0713	0.0000	SURCHARGED
15 minute winter	2	12	20.894	0.589	31.1	0.1042	0.0000	SURCHARGED
15 minute winter	3	12	20.886	0.762	26.0	0.1349	0.0000	SURCHARGED
30 minute winter	Attenuation	30	20.479	0.103	65.7	31.0460	0.0000	OK
15 minute winter	Channel 3	12	20.800	0.300	9.7	0.0213	0.0000	SURCHARGED
15 minute winter	4	12	20.779	0.404	59.8	1.0277	0.0000	SURCHARGED
15 minute winter	Channel 1	12	20.815	0.315	4.2	0.0224	0.0000	SURCHARGED
15 minute winter	5	12	20.807	0.504	45.4	0.8910	0.0000	SURCHARGED
15 minute winter	6	12	20.851	0.614	37.0	0.6946	0.0000	SURCHARGED
15 minute winter	Channel 2	12	20.893	0.393	13.2	0.0279	0.0000	FLOOD RISK
15 minute winter	Junction 1	12	20.867	0.705	35.5	0.0000	0.0000	SURCHARGED
15 minute winter	7	12	20.872	0.822	31.7	0.9296	0.0000	SURCHARGED
15 minute winter	8	12	20.877	0.852	30.9	2.1678	0.0000	SURCHARGED
15 minute summer	8_OUT	1	20.008	0.000	15.0	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute winter	1	1.000	2	11.8	0.464	0.151	2.7468	
15 minute winter	2	1.001	3	17.8	0.563	0.227	2.5500	
15 minute winter	3	1.002	8	21.3	0.327	0.260	1.2761	
30 minute winter	Attenuation	2.000	4	-62.1	-1.643	-3.499	0.1370	
15 minute winter	Channel 3	3.000	4	16.6	0.627	0.079	0.2503	
15 minute winter	4	2.001	5	-48.4	-0.687	-0.759	1.5224	
15 minute winter	Channel 1	4.000	5	5.3	0.080	0.045	1.2368	
15 minute winter	5	2.002	6	-37.2	0.694	-0.584	1.3984	
15 minute winter	6	2.003	Junction 1	-29.8	0.830	-0.354	0.9178	
15 minute winter	Channel 2	5.000	Junction 1	13.7	1.288	0.162	0.3950	
15 minute winter	Junction 1	2.004	7	23.0	0.609	0.275	1.3921	
15 minute winter	7	2.005	8	30.9	0.594	0.410	0.3805	
15 minute winter	8	Hydro-Brake®	8_OUT	15.0				43.3



**Results for 100 year Critical Storm Duration. Lowest mass balance: 99.83%**

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	1	11	21.106	0.605	13.2	0.1072	0.0000	FLOOD RISK
15 minute winter	2	11	21.103	0.798	24.5	0.1412	0.0000	FLOOD RISK
15 minute winter	3	11	21.082	0.958	27.5	0.1696	0.0000	FLOOD RISK
60 minute winter	Attenuation	50	20.536	0.160	64.1	48.0913	0.0000	OK
15 minute winter	Channel 3	11	20.955	0.455	15.3	0.0323	0.0000	FLOOD RISK
15 minute winter	4	11	20.954	0.579	87.8	1.4731	0.0000	SURCHARGED
15 minute winter	Channel 1	11	20.989	0.489	7.0	0.0347	0.0000	FLOOD RISK
15 minute winter	5	11	20.999	0.696	63.8	1.2303	0.0000	SURCHARGED
15 minute winter	6	11	21.010	0.773	51.7	0.8737	0.0000	FLOOD RISK
15 minute winter	Channel 2	11	21.000	0.500	28.8	0.0355	3.3741	FLOOD
15 minute winter	Junction 1	11	21.014	0.852	40.1	0.0000	0.0000	FLOOD RISK
15 minute winter	7	11	21.048	0.998	39.3	1.1292	0.0000	FLOOD RISK
15 minute winter	8	11	21.054	1.029	37.1	2.6195	0.0000	FLOOD RISK
15 minute summer	8_OUT	1	20.008	0.000	15.0	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute winter	1	1.000	2	11.2	0.457	0.143	2.7468	
15 minute winter	2	1.001	3	19.4	0.543	0.248	2.5500	
15 minute winter	3	1.002	8	29.7	0.421	0.362	1.2761	
60 minute winter	Attenuation	2.000	4	-60.0	-1.707	-3.384	0.1415	
15 minute winter	Channel 3	3.000	4	14.8	0.630	0.071	0.2504	
15 minute winter	4	2.001	5	-67.4	-0.957	-1.057	1.5224	
15 minute winter	Channel 1	4.000	5	-7.0	-0.153	-0.059	1.2368	
15 minute winter	5	2.002	6	-54.2	-0.770	-0.851	1.3984	
15 minute winter	6	2.003	Junction 1	-42.4	0.828	-0.504	0.9178	
15 minute winter	Channel 2	5.000	Junction 1	-15.4	1.245	-0.181	0.3950	
15 minute winter	Junction 1	2.004	7	-38.5	0.594	-0.462	1.3921	
15 minute winter	7	2.005	8	37.1	0.611	0.493	0.3805	
15 minute winter	8	Hydro-Brake®	8_OUT	15.2				55.0





**Results for 100 year +40% CC Critical Storm Duration. Lowest mass balance: 99.83%**

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m <sup>3</sup> )	Flood (m <sup>3</sup> )	Status
15 minute winter	1	10	21.319	0.819	13.4	0.1450	0.0000	FLOOD RISK
15 minute winter	2	10	21.306	1.001	38.1	0.1771	0.0000	FLOOD RISK
15 minute winter	3	11	21.239	1.115	45.6	0.1973	0.0000	FLOOD RISK
60 minute winter	Attenuation	42	21.071	0.695	89.4	63.7778	0.0000	FLOOD RISK
15 minute winter	Channel 3	10	21.096	0.596	17.5	0.0424	0.0000	FLOOD RISK
15 minute winter	4	10	21.095	0.720	109.1	1.8336	0.0000	FLOOD RISK
15 minute winter	Channel 1	10	21.094	0.594	17.4	0.0422	0.0000	FLOOD RISK
15 minute winter	5	10	21.113	0.810	75.5	1.4319	0.0000	FLOOD RISK
15 minute winter	6	10	21.134	0.897	63.9	1.0142	0.0000	FLOOD RISK
60 minute winter	Channel 2	42	21.000	0.500	34.2	0.0355	12.4453	FLOOD
15 minute winter	Junction 1	10	21.127	0.965	61.3	0.0000	0.0000	FLOOD RISK
15 minute summer	7	11	21.180	1.130	53.6	1.2785	0.0000	FLOOD RISK
15 minute winter	8	11	21.191	1.166	46.9	2.9670	0.0000	FLOOD RISK
15 minute summer	8_OUT	1	20.008	0.000	16.1	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m <sup>3</sup> )	Discharge Vol (m <sup>3</sup> )
15 minute winter	1	1.000	2	14.6	0.473	0.186	2.7468	
15 minute winter	2	1.001	3	31.9	0.582	0.408	2.5500	
15 minute winter	3	1.002	8	46.9	0.666	0.573	1.2761	
60 minute winter	Attenuation	2.000	4	-83.3	-1.851	-4.694	0.2570	
15 minute winter	Channel 3	3.000	4	19.6	0.631	0.094	0.2504	
15 minute winter	4	2.001	5	-77.3	-1.097	-1.212	1.5224	
15 minute winter	Channel 1	4.000	5	-17.4	-0.354	-0.148	1.2368	
15 minute winter	5	2.002	6	-64.6	-0.918	-1.015	1.3984	
15 minute winter	6	2.003	Junction 1	-50.8	0.868	-0.604	0.9178	
60 minute winter	Channel 2	5.000	Junction 1	-28.5	1.005	-0.335	0.3950	
15 minute winter	Junction 1	2.004	7	-61.3	-0.871	-0.735	1.3921	
15 minute summer	7	2.005	8	37.4	0.614	0.497	0.3805	
15 minute winter	8	Hydro-Brake®	8_OUT	16.1				71.1